

**Exhaust Line of an Internal Combustion Engine
Having Controllable Exhaust Flaps**

BACKGROUND OF THE INVENTION

[0001] This application claims the priority of German patent application 103 09 468.7, filed 03 March 2003, the disclosure of which is expressly incorporated by reference herein.

[0002] The present invention relates to an exhaust line of an internal combustion engine of the type disclosed in DE 42 12 215.

[0003] In the known configuration, the exhaust line of an internal combustion engine is provided with a startup catalytic converter installed near the engine. A central channel, which is surrounded by a catalytic converter body, is provided in the housing of the startup catalytic converter. This central channel is controllable by an exhaust flap such that the exhaust flows through the body of the catalytic converter when the flap is closed and the exhaust flows through the central channel when the flap is open. Such an arrangement is frequently used to bring the catalytic converter to the operating temperature as rapidly as possible.

SUMMARY OF THE INVENTION

[0004] With the triggering of the exhaust flap in accordance with the present invention, a double-pass exhaust system with one preliminary catalytic converter and one main catalytic converter is provided. The preliminary catalytic converters here again sits directly behind the bends in an area near the engine, and the main catalytic converter is integrated into the end muffler. With today's vehicles, because of the high demands, often there is only a minimum amount of space for integrating the exhaust system. Therefore with modern exhaust systems, which should meet all the statutory noise limits at a minimum exhaust pressure and a high engine load despite their low muffler volume, the muffler is configured as a flap end muffler.

[0005] According to the features of the method of the present invention, these exhaust flaps are to be triggered as a function of a stored engine characteristics map stored. A wide variety of parameters, such as the gas pedal gradient, the engine temperature, the lambda values, etc. may be included in the engine characteristics map, but in particular the vehicle speed, the engine rpm, the gear engaged and the engine load are essential parameters that are included in triggering the exhaust flaps.

[0006] Definite improvements in the performance requirements in low gears can be achieved through the triggering of the exhaust flaps as a function of the engine characteristics map according to the present invention.

[0007] Another advantage is that separate engine characteristics maps can be stored, providing the driver with either a very sporty performance of the vehicle, for example, or a more comfort-emphasized driving sound when driving in city traffic and thus providing a quiet driving performance. This yields a definite increase in comfort for the driver of the vehicle.

[0008] Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a schematic diagram showing the basic configuration of a flap exhaust system, and

[0010] FIG. 2 is a flow diagram showing the individual method steps for implementing the method of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

[0011] FIG. 1 shows the basic configuration of a flap exhaust system, including a vacuum storage device 10 connected to an intake system 12 by a nonreturn valve 11. In parallel with this the vacuum storage device 10 is connected to a solenoid valve 13 which is triggered by the engine control unit 14 and whose output is sent to the exhaust system 15. The functioning of

such an exhaust system with triggerable exhaust flaps is essentially known and therefore need not be explained in detail.

[0012] FIG. 2 shows the essential steps for implementing the inventive method. In a first working step 20, the various input variables for determining the triggering process of the exhaust flaps are determined. These input variables include for example the rotational speed n , the vehicle speed v , the load L , the engaged gear G and other contemplated variables, such as the temperature and the driver's intent. In a following working step 21, the control variables are determined with the help of at least one stored engine characteristics map for the exhaust flaps on the basis of the input variables thus determined. It is also contemplated here that different engine characteristics maps can be accessed, all such maps being stored in the engine control unit 14. Possible engine characteristics maps for triggering the exhaust flaps are indicated clearly in working step 21 as the engine characteristics map $KF1$ through engine characteristics map KFn . As soon as the shifting conditions for the exhaust flaps have been met in working step 21, the output of a signal to the solenoid valve 13 takes place in working step 22. This releases the passage from the vacuum storage device to the vacuum dashpot of the exhaust flaps. Because the vacuum storage device of the exhaust system is connected directly to the intake system via a nonreturn valve 11, a vacuum is built up in the intake system and the vacuum storage device is acted upon when the combustion engine is running and the throttle

valve is closed. The vacuum storage device used is not absolutely necessary for the triggering. The exhaust flaps may also be operated directly by electric actuators. Triggering of the actuators may also be accomplished by the engine control unit.

[0013] With the triggering of the exhaust flaps according to the present invention, whereby not only the speed of the vehicle but also the overall requirements of the engine and the exhaust system are taken into account, to various problems can now be solved in a controlled manner. Thus, for example, interfering gas exchange noises such as droning or drumming which occur at certain rotational speeds and engine loads can be reduced or completely eliminated by a controlled triggering of the exhaust flaps. At the same time, an extremely sporty sound can be stored in the engine characteristics map in the control unit and thus give the driver a feeling of extreme agility.

[0014] In addition, racing operation can be recognized in vehicles which are allowed as street-legal vehicles and are also designed for racing operation. This is accomplished by recognizing the required engine power and/or torque. In this manner, engine characteristics maps for the exhaust flaps that are based on optimum power and torque can be selected.

[0015] The foregoing disclosure has been set forth merely to illustrate the invention and is not intended to be limiting. Since modifications of the

disclosed embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed to include everything within the scope of the appended claims and equivalents thereof.